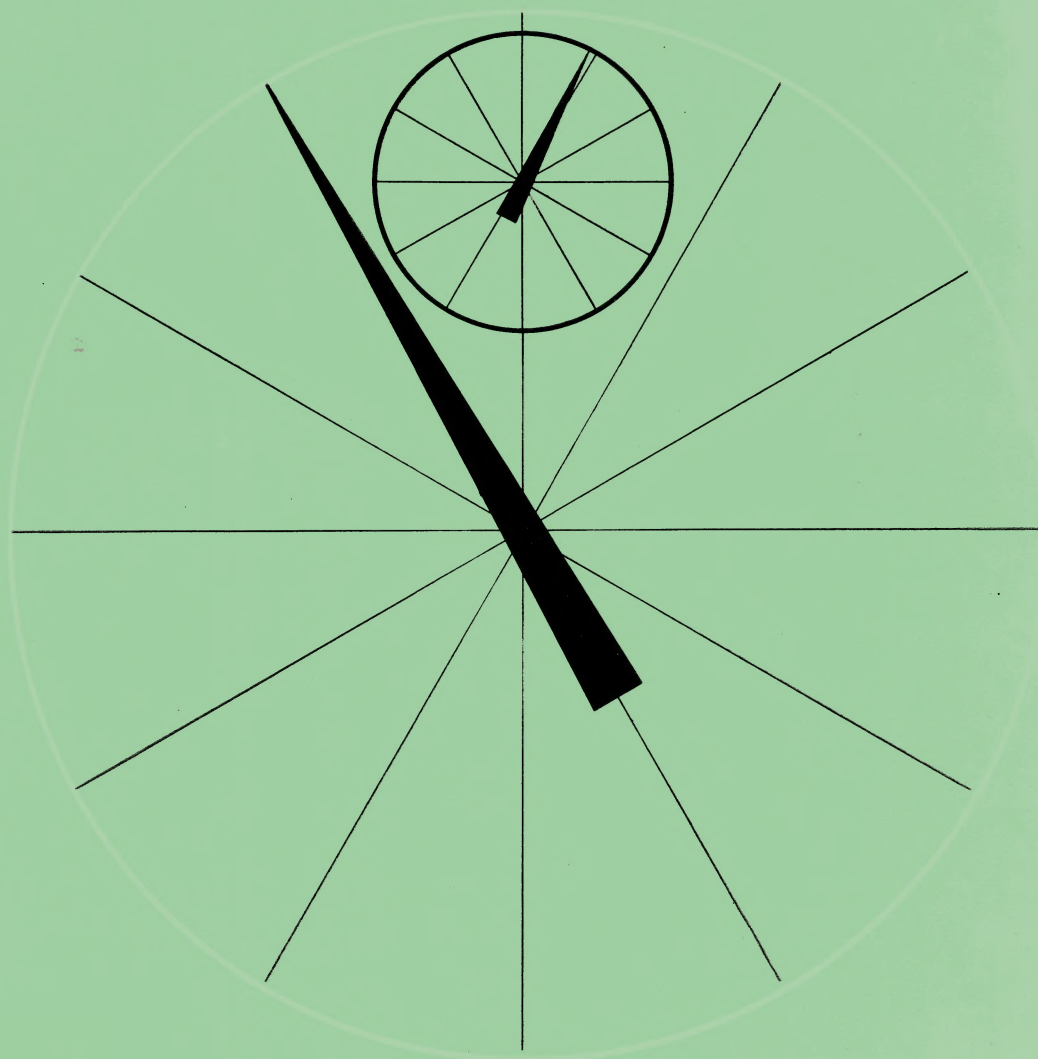# CUTTING REACTION TIME

Introduction

TELE-PROCESSING is the trademark adopted by IBM to indicate its range of products for communication-based data processing. IBM TELE-PROCESSING systems range from point-to-point transmission of data, to the remote input, output and control of large-scale data processing systems.

This booklet describes a number of IBM TELE-PROCESSING products, and also includes a section on conversion equipment, since the translation of data between paper tape, punched card, magnetic tape and printed forms is often a necessary part of a communication-based data processing procedure.

For further information on any of the products described or mentioned in this booklet, please get in touch with the Branch Manager at your nearest IBM office. The addresses are given on the back cover.

IBM 1001

Data Transmission Terminal

IBM TELE-PROCESSING – at lowest cost

The IBM 1001 Data Transmission system is announced for use in the United Kingdom over private internal telephone systems.

Input

At each data originating point there is an IBM 1001, consisting of a simple card reader with a keyboard. This equipment permits the automatic transmission of data from prepunched cards, and of variable data manually keyed. Any numerical data may be transmitted, and card read-

ing and manual keying may be combined according to requirements. The data is received by a card punch at a central location, under the control of five keys on the transmitting keyboard.

Connection between the data originating point and the receiving card punch is established by conventional dialling. Prepunched cards, each representing, for example, an item to be requisitioned or reported, are pulled from a tub file and inserted into the 1001 reader one by one. Up to 22 columns of prepunched numerical data may be transmitted automatically at about 12 columns a second. Along with each card, variable data such as amounts or prices may be keyed in manually for transmission and punching into the same output card.

That portion of the prepunched card which is not used for transmission may of course contain alphabetic information, interpreted if necessary for ease of reading the card.

Output

At the central receiving location, the data transmitted from an originating point is fed through a data translator to a card punch. This punch, an IBM 024 or 026, automatically punches all the transmitted data into cards. If the data generated by one transaction occupies less than a full card, one output card may contain the data for several transactions.

After punching, the output cards may be fed into an accounting machine to print despatch notes, invoices, etc; or into a RAMAC system, or other data processing system, to up-date accounting and stock records at the same time as producing the necessary printed documents.

If the cards are produced on an 026 printing punch, they themselves may be used as active documents.

More than one punch may be installed if a large number of cards have to be re-

ceived within a short period. When not in use as a receiving station for 1001 Data Transmission Terminals, these punches may be used for normal manual card punching.

No operator is required at the central location, since the data translator makes it possible for the person at the data originating point to dial direct to the receiving punch, at any time of the day or night. If there are several receiving punches, a call is automatically connected to a free punch.

Checking Facilities

Data for transmission is coded in a 2-out-of-8 code, and there is automatic parity checking to ensure the accuracy of received data.

Besides parity checking there is a check on the length of records and a self-checking number feature is available in a 1001 system. A check digit can be calculated from any number (e.g. a part number), and this check digit may be re-calculated by the receiving punch. A discrepancy causes a 12 to be punched in the units position of the field, and punching is suspended for the operator to take corrective action.

Application
Library Circulation Control

Of the many applications to which the 1001 is suited, library circulation control is here chosen to illustrate the potential uses of this TELE-PROCESSING system.

All book cards and borrower cards are converted to 22-column IBM punched cards. This can be done gradually, or the job may be handled by an IBM Service Bureau. This done, a book is charged out by inserting the borrower card into the 1001 terminal, followed by the book card. The due date is either duplicated at the receiving end, or keyed in. All the necessary data is therefore punched into an 80-column card at the remote central

processing point, which may serve a number of libraries connected by suitable telephone circuits. The book card is replaced in its pocket, and the borrower card returned to the borrower.

Returns are dealt with by inserting the book card alone into the 1001 terminal. An 80-column card is punched without the borrower's number at the central processing point, where it is automatically matched with the issue card. Fine notices for overdue returns, and reminders for overdue books which have not been returned, may be produced automatically if the volume is too large for manual procedures.

Four issues can be handled in a minute.
Eight returns can be handled in a minute.
The system can be economically expanded if the volume increases.
There are complete facilities for obtaining the fullest possible statistics.
The system is lower in cost than specialised punched card equipment now in use for the purpose.

IBM Data Transceivers

Transmission of Punched Card Data by Telephone or Telegraph Line.

There are two IBM Data Transceivers, the 065 and the 066. Both read and punch cards, the 066 has the additional feature that at the same time as punching it can print the data along the top edge of the card.

The Data Transceiver requires a signal unit to connect it with the transmission lines. The IBM 067 Telegraph Signal Unit connects an 065 or an 066 to a telegraphic line. The IBM 068 Telephone Signal Unit connects an 065 or 066 to a Tariff D or E private telephone line.

The speed of operation is governed by the type of line used and the type of punch.
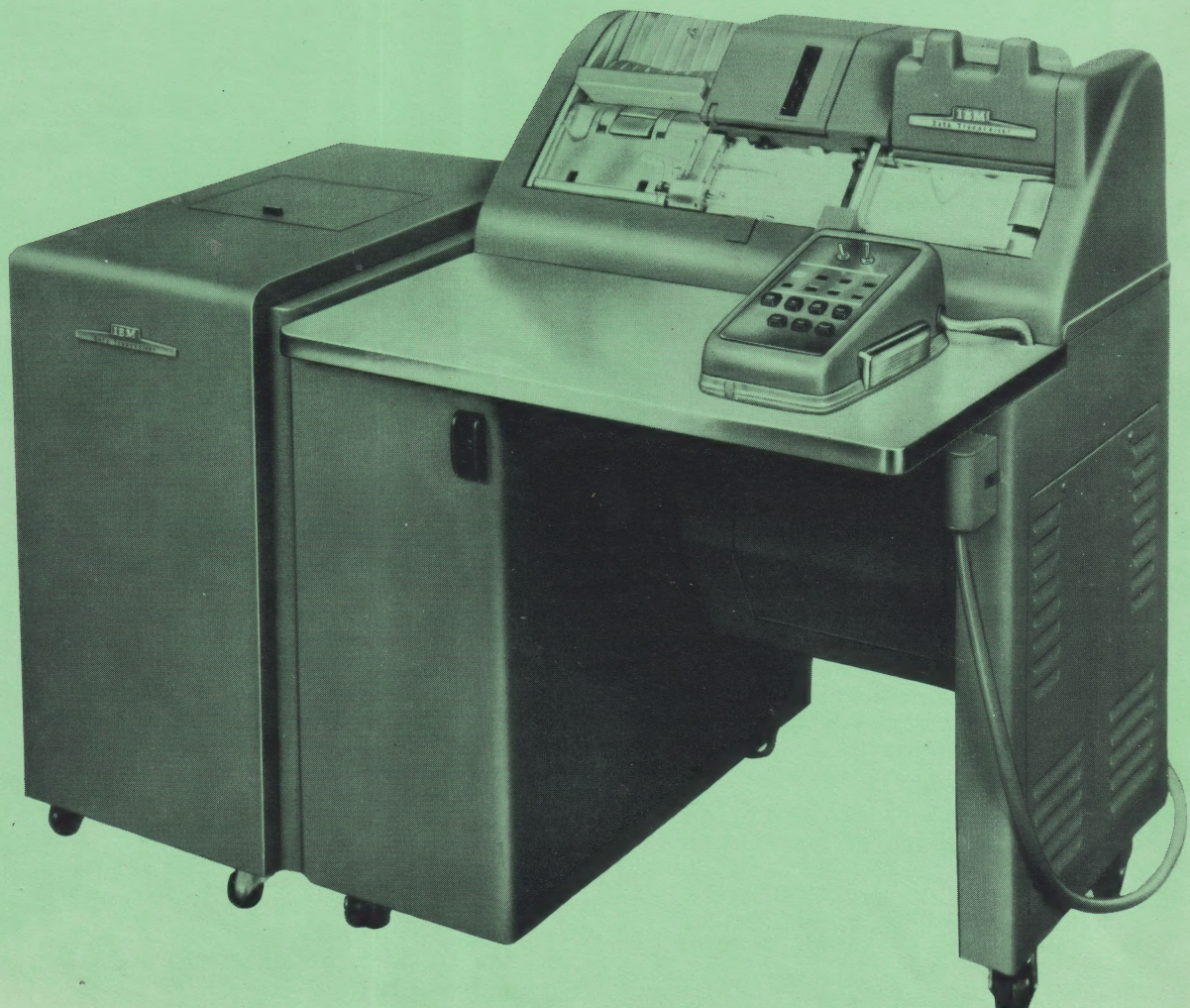
The maximum speed of the transceiver itself is 16 columns a second (IBM 065) or 14 columns a second (IBM 066), giving a transmission rate of about 10 fully-punched 80-column cards per minute. If less than 80 columns are punched, the remainder of the card is skipped at high speed, and the effective transmission rate is correspondingly higher.

The maximum speed of a telegraphic system is governed by the speed of the carrier, 6.67 characters per second. This gives a transmission rate of about 3 fully-punched cards per minute.

A transceiver is a dual-purpose machine which may either transmit data to another transceiver, or receive it. Thus two transceivers are necessary to complete a circuit, but data may be transmitted in either direction. The originating unit reads punched cards and transmits some or all of the data to the receiving unit, which punches it in another card. The program drum on each unit makes it possible to select data and control skipping.

More than one pair of transceivers may be attached to a single telephone line if required. Up to four pairs may operate in either direction simultaneously, according to the type of line.

Checking Facilities

A synchronising pulse ensures that the two units remain in full co-ordination. Data is transmitted in a 4-out-of-8 code, and parity checking on each character ensures the accuracy of transmission, while other checks compare the number of characters read and punched. When each card is released the originating unit sends an 'end of card' signal, and awaits a 'go-ahead' signal from the receiving unit before continuing with the next card.

If any error is detected, transmission is suspended while the error card is removed and checked. For uninterrupted batch transmission, however, the Successive Card Checking feature is available. With this feature any error cards are offset in both stackers. When the complete batch has been transmitted the offset cards can be removed from both units, corrected as necessary, re-transmitted and replaced in the correct order in their respective batches.

Applications

Data transceivers may be used for many purposes requiring the immediate availability of extremely accurate and reliable data at a point removed from where the data is available. Some actual examples of the use of data transceivers are briefly described to illustrate the applications of these machines.

Aircraft Test Data

Data transceivers have been used to link test bases with computer locations for the processing of pre-certification flight data and subsequently for the quick relay of flight test readings to an IBM 704. Data recorded on a morning flight is transmitted over leased telephone lines to the computer, which interprets the data and relays the results back to the test crews. These results are used in planning the next flight, which often occurs the same afternoon.

Multi-Payroll Problem

Payroll information must sometimes be collected from widely separated plans operating on critical time schedules. Data transceivers have been used by such remote plants to transmit the information to the unit record IBM installation which processes the overall payroll. Output data is immediately distributed back to the payroll locations so that payment can be made at once.

General Accounting

A company which does manufacturing research on electronic equipment has used data transceivers to send data daily from its factories to the central office. By this means cost recordings, payroll, stock accounting, labour distribution, material distribution, journal entries and budget and expense records are all processed by unit record equipment at the central office.

Stock Order Requirements

Four data transceivers and an IBM 305 RAMAC system have been used to process more than 2000 remote inquiries each day concerning more than 45,000 fabricated part orders from shops within a factory. Up-to-date records on the availability of all parts are held in the random access disc storage of the 305, where one of the transceivers is located. The other three are in the shop control areas. Parts orders are sent from the shop control area to the 305 installation and checked for availability, and within minutes the request is transmitted to the stock area.

IBM 7701
Magnetic
Tape
Transmission
Terminal
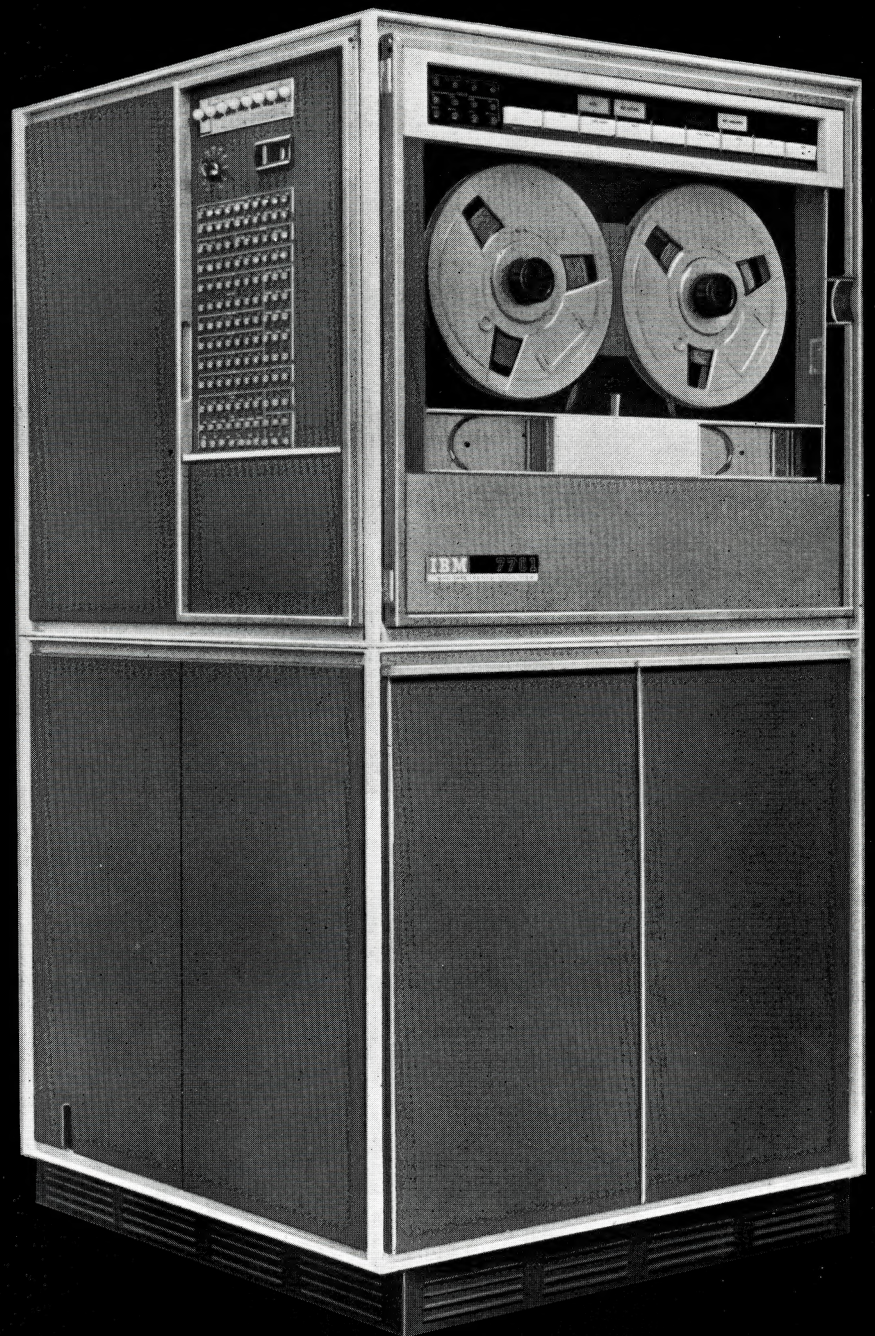
Large-Volume Magnetic Tape Data Transmission

Larger organisations which have more than one data processing system using magnetic tape input and output are likely to be faced with the need to process reels of magnetic tape at one installation which were written at another. Where records must be kept in line with stock levels, production or sales figures, it will sometimes be essential to get this information from one place to another more quickly than would be possible by sending the actual reel of tape.

Data recorded on magnetic tape at a density of 200 characters per inch on IBM 727, 729 I, II or IV or 7330 tape units is read and transmitted by the 7701 at a speed of 150 characters per second. The data may be received either by another 7701 or by a 1401 data processing system through an IBM 1009 Transmission Unit (described in the next section). Similarly, a 7701 can receive data from a 1401-1009 system.

The records are transmitted without change of format, and may be of any length acceptable to the data processing equipment involved, though records between 300 and 3000 characters in length are recommended.

The 7701 places the power and versatility of a large central data processing installation such as an IBM 1410 or 7000-series system at the service of every divisional or regional DP installation using magnetic tape units. Widely separated company locations may be connected by leased Tariff D or E private speech lines.

Checking Facilities
There is a check on the correct transmission of data from one unit to another, and in case of error the 7701 automatically makes two further attempts to transmit the record. If it has not been transmitted with absolute accuracy after the third attempt, the operators at both terminals are alerted to take corrective action.

Applications
Large volumes of data from a factory or sales office may be transmitted to a 7701 terminal at a Head Office central computer installation. There it may be used, together with master tapes, as input for payroll, costing, stock control, invoicing and other routine runs. A sales office can, for example, transmit a daily tape containing all the orders received during the day, including modifications to existing orders and cancellations. Tape-to-tape transmission may also be used for routine inquiries which require an answer the following day, yet are not sufficiently urgent to merit interruption of the central data processing system to obtain an immediate reply.

Tapes from factory, laboratory, sales office or subsidiary company may be transmitted to a Head Office to up-date records stored in a RAMAC file. RAMAC is often used because of its ability to keep records always as up-to-date as the last transaction, and where large distances are involved IBM TELE-PROCESSING equipment may be necessary to the smooth operation of the procedure.

Output tapes from central processing runs may be transmitted to different points throughout a wide area, ready for immediate local processing, such as printing payslips, stock requisitions etc.

Tape-to-tape transmission may also be used from one part of a company structure to another. A complete production schedule of goods ordered by a particular branch or area may be transmitted from factory to sales office direct, as well as being relayed to the central processing system. Companies engaged in complex research and development programmes will find the 7701 terminal particularly valuable in the rapid and completely reliable transmission of detailed test data from experimental area to laboratory, laboratory to computing centre, or from laboratory to factory.

IBM 1009 Data Transmission Unit

Direct Computer-to-Computer Communication

The 1009 is a unit of a 1401 data processing system which can accept data from any other unit of the system, through the core storage, for transmission to another 1009 or to a 7701; and can relay information from another 1009 or from a 7701 to any other unit of the 1401 system.

It therefore virtually converts a 1401 into a punched card, punched paper tape or magnetic tape data transmission terminal.

Data is read from core storage under program control to the 1009, or from the 1009 to core storage. Data from any input unit can be selected by the program for transmission, and data received from the 1009 can be transferred to any output unit.

Transmission, at a speed of 150 characters a second, is by way of private GPO Tariff D or E speech lines. Modulating and demodulating equipment is also necessary to translate the data from 1401 coding to a serial code.

Checking Facilities

The serial 4-out-of-8 code used for transmission is automatically checked for accuracy, and the record is automatically retransmitted in case of error. If it has still not been transmitted with absolute accuracy after the third attempt, the operators at both terminals are alerted to take corrective action.

Applications

Not only data, but routines and subroutines can be transmitted from one 1401 to another by way of 1009 units, and programs controlling each system can be designed to interrogate a specific storage location to check whether information has been received. Thus results of calculations performed by one system can be relayed to another, and a coded signal transmitted to enable the receiving machine to branch to a subroutine to perform further operations upon the results. The results of these operations may in turn be returned to the first system for final processing.

This joint operation of two 1401 systems can be useful in the day-to-day dynamics of materials management, stock control, production scheduling, despatching, cost accounting and operations assessment.

Special Equipment

A particular user may often have special requirements which cannot be met by the normal IBM TELE-PROCESSING equipment available. However, if the suitable means of transmission are available, the TELE-PROCESSING equipment can usually be adapted to the special needs.

Microwave Transmission

In 1959 a microwave tape-to-tape link was set up in California for North American Aviation. This company required direct contact between the Los Angeles International Airport and the Rocketdyne Division at Canoga Park, over 30 miles away. By co-operation with the Pacific Telephone and Telegraph Company, existing television lines are used to carry data to microwave antennae, whence it is beamed to a mountain-top relaying point and on to the other terminal. The distance required for direct line-of-sight transmission comes to some 40 miles.

By using seven 240-kilocycle bands, with double sideband amplitude modulation, the seven channels of IBM magnetic tape are transmitted simultaneously. An eighth band is used to transmit control signals to start and stop tape units at each end, and for general channel supervision. IBM 727 Magnetic Tape Units are used, with suitable connecting equipment. Data enters the buffer units at a speed of 15,000 characters a second, and the effective rate of transmission for 1000-character records is about 13,000 characters a second. The net rate, allowing for reading and writing, is about 6,500 characters a second. A full-length reel of tape, containing about 5000 1000-character records (5 million characters) can be transmitted in 12.8 minutes.

Tapes prepared on the Los Angeles 705 are transmitted for processing on the two 709's at Canoga Park. (The Los Angeles International Airport Office also operates a 709, and the company Corporate Office two 705's.)

Scientific work accounts for the transmission of 12 reels of data each day from Canoga Park, and 3 reels a day in the opposite direction. On Sundays commercial work will amount to 15 reels from Canoga Park and 12 reels in the other direction.

Airline Reservations

The IBM 9090 was specially developed to provide an immediate clearing house of up-to-the-second reservation information for airline reservation agents throughout the USA. While he is talking to a customer, an agent can inquire about the availability of seats on any flight and book a seat on the desired flight, all by means of a special console which connects directly with the central reservation storage units. The agent can give his customer full information on seat availability on any flight, store a complete passenger name and address record, provide departure and arrival times of all the day's flights throughout the entire system, receive notifications of flight changes to be notificed to the passengers concerned, and communicate with other airlines to request space on their flights.

The console transmits a flight enquiry to the central IBM 9090 Random Access Storage Unit, which refers to the relevant record and immediately replies to the console. If more than one flight or route is available between two points, complete information on the alternatives is given, so that the passenger can make his choice. The agent then records the booking, and the central computer amends the seat plan for that flight accordingly.

The result is better service to passengers, and better control information for management than was ever before possible.

Other Special Equipment

Other special equipment for IBM TELE-PROCESSING products includes data communication channels and real-time channels for most of the IBM 7000-series systems. Such special devices as a typewriter connection to data transceivers; Telex channels on 305 RAMAC's; and modifications to 357 data collection systems – these too make many variations possible for particular applications.

Data Conversion Equipment

1 Card to Paper Tape, and Vice Versa

IBM 063 Card Controlled Tape Punch
IBM 046/047 Punched Tape to Card Punch
Telegraphic Checkable Code Feature

The 063 can punch 5, 6, 7, or 8 channel chad or chadless paper tape from data contained in punched cards, at a speed of 10 characters per second. 5-channel paper tape can be transmitted over GPO telegraph lines at a speed of 7 characters per second, and with the Telegraphic Checkable Code feature, a check code character will be punched at the end of each 'unit
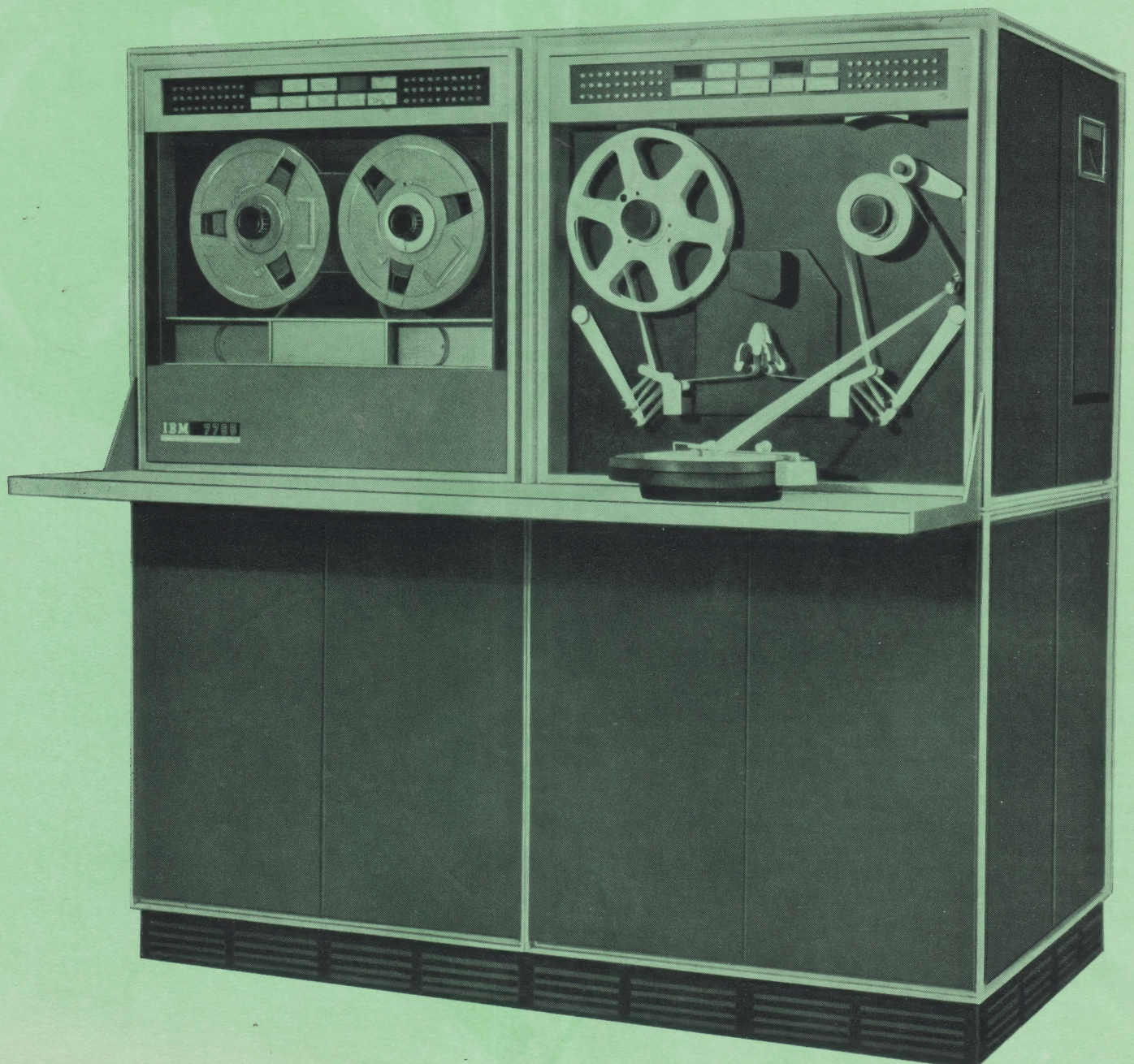
record'. This character will be transmitted as part of the message, and used at the receiving end to check the accuracy of transmission.

The 046 and 047 convert data read from punched paper tape (received over a telegraph line, or created as a by-product of another operation) into conventional 80-column punched cards. The speed of operation is 20 columns a second (with the 046) or 18 columns a second (with the 047). At the same time as punching the 047 can print the data along the top edge of the card.

During tape to card conversion the sum of the holes punched is accumulated from the input tape, and the units digit of this sum is compared with the check digit.

2 Simultaneous Conversion Into Two or More Forms

IBM 870 Document Writing System.
The 870 is a connected system made up of some or all of the following units:

Input   Card reader
Alphanumerical keyboard
Numerical keyboard
Paper tape reader
Output Card punch (with or without print unit)
Paper tape punch
Non-transmitting typewriter

This system enables an operator to produce several forms of output, perhaps with quite different formats, from one operation. It can also be used for data conversion from card to tape, card to printer, tape to card, tape to printer. The speeds are governed by output speeds, 20 columns a second card punching; 18 characters a second tape punching; and 10 characters a second typing.

3 Paper Tape to Magnetic Tape

IBM 7765 Paper Tape to Magnetic Tape Converter.

The 7765 reads data from 5, 6, 7 or 8 channel punched paper tape and writes this data on IBM magnetic tape, at a density of 200 characters per inch. The tape thus produced can be processed on IBM 727, 729 I, II or IV and 7330 Magnetic Tape Units, at information transfer rates up to 22,500 characters per second. The speed of operation of the 7765 is 150 characters per second.

Much information is transmitted over telegraph lines by means of punched paper tape, and paper tape is often punched in the course of routine clerical and accounting operations. It is often desirable to use this data for input to a data processing system, but although some computers do use paper tape as a direct input medium, large volumes are normally more effectively handled on magnetic tape.
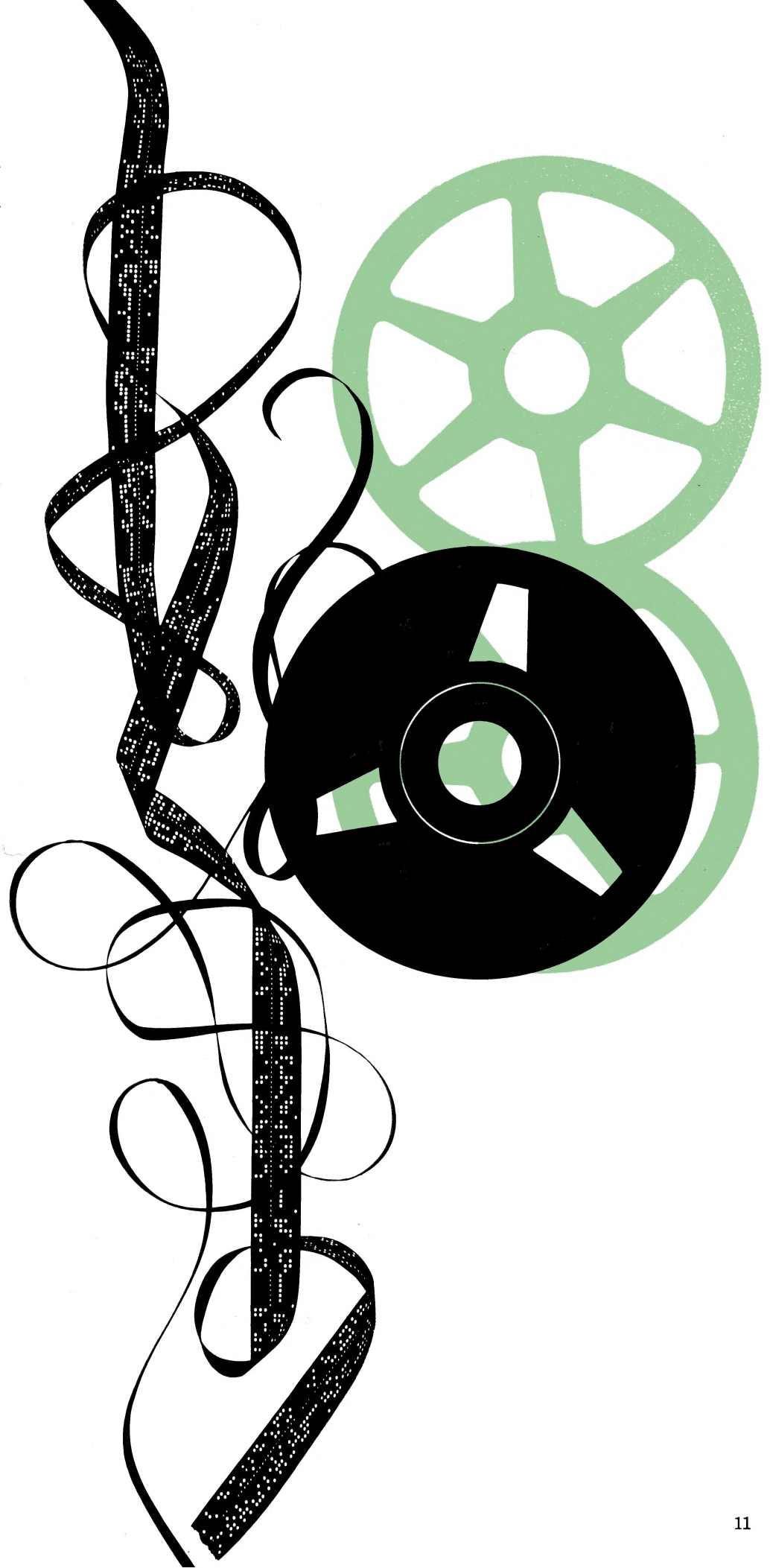
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